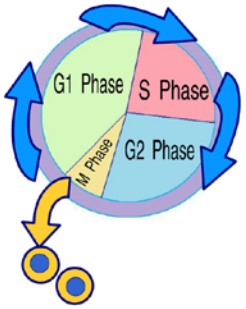
Unit 6 Mitosis



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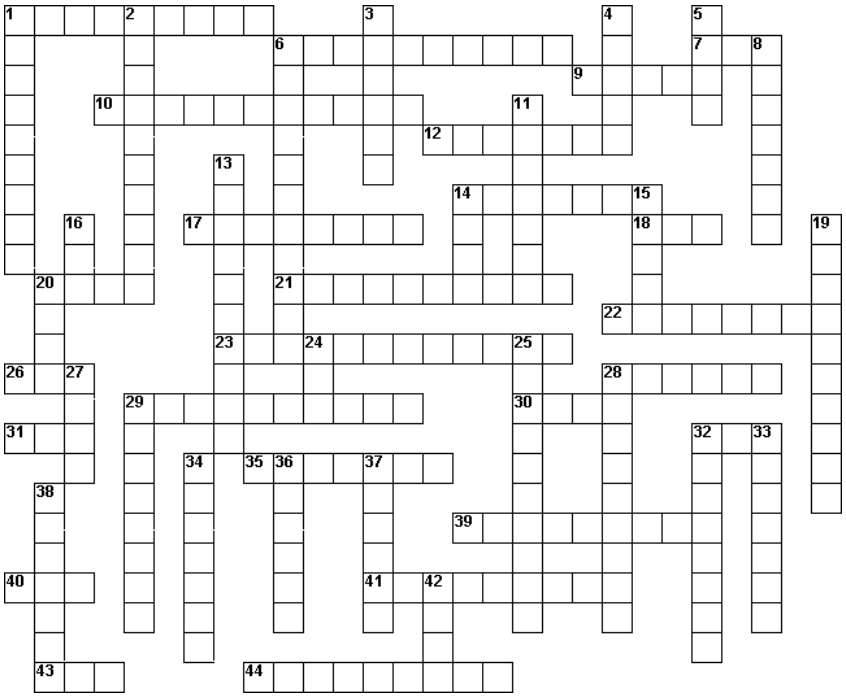
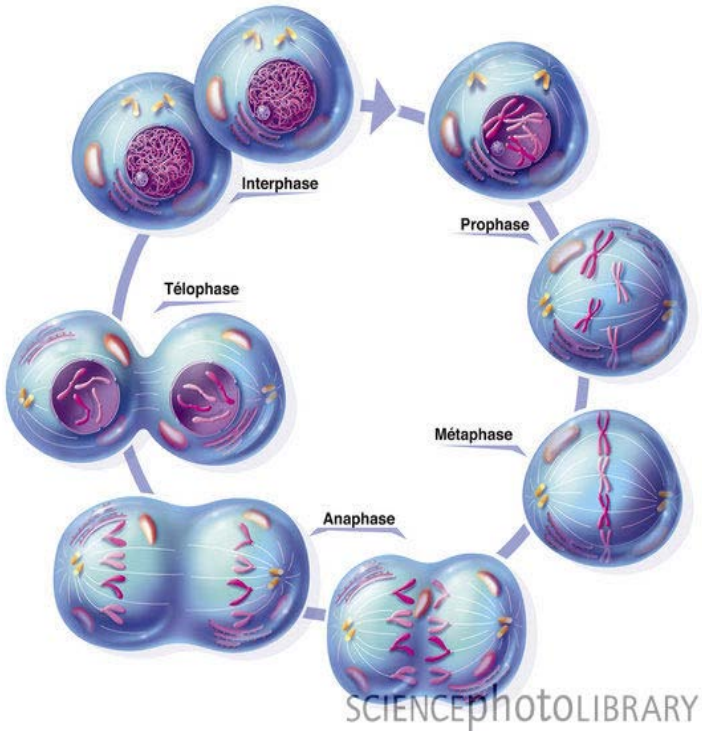


ACROSS CLUES:

1. One member of a chromosome doublet.
6. Dark-staining body (composed of 2 chromatids) inside a cell during M-phase.
7. Chromosome number of sterile animal such as a mule.
9. Body part with definite physiological function (made of more than one tissue).
10. Shrinkage of the cell contents (within cell membrane) due to water loss.
12. Prominent intracellular plant organelle that contains mostly water.
14. World's smallest flowering plant that produces the world's smallest fruit.
17. Phase of mitosis when conjoined sister chromatids separate from each other.
18. Number of haploid sets in a hexaploid cell.
20. Diameter of field of view in millimeters when using the 4X objective.
21. Purple, grape-like bodies inside cells of a potato tuber.
22. Phase of mitosis when chromosomes become visibly shortened and thickened.
23. Organelle site of cellular respiration and ATP production.
26. Number of haploid sets of chromosomes in a decaploid cell.
28. Aggregation of the same type of cells all performing a similar function.
29. Exactly 1000 of these metric units equals one millimeter.
30. Color of dye used to stain cheek epithelial cells in Biology 100 lab.
31. A female chicken (domestic fowl). [The opposite of a rooster.]
32. Acronym for Palomar Community College.
35. Movement of water molecules through a selectively-permeable cell membrane.
39. Phase of mitosis when chromosome doublets line up along equatorial plate.
40. Primary molecular composition of chromatids--in addition to protein.
41. Site of synthesis of ribosomal RNA within the nucleus of a cell.
43. A haploid female reproductive cell.
44. Minute, membrane-bound structure in cytoplasm with a specific function.

DOWN CLUES:

1. Occurs in the cytoplasm of animal cells during M-phase (typically in pairs).
2. Approximately 25 of these metric units makes one inch.
3. Stain used to test for the presence of starch molecules.
4. How many cubical grains of ordinary table salt (NaCl) equals one millimeter?
5. Number of Barr bodies inside the cheek cell of a human male.
6. Photosynthetic organelle inside plant cells.
8. Cell with two sets of chromosomes.
11. Mitosis actually refers to the division of this organelle into duplicates.
13. Region where 2 chromatids of a chromosome doublet are attached.
14. Plant cell structure composed of cellulose and lignin.
15. Radiating protein strands at poles of an animal cell during M-phase.
16. Number of sets of chromosomes in a diploid cell.
19. Phase of cell cycle when the organelles and chromosomes replicate.
20. Number of cells in field of view with 4X objective (each cell is 0.8 mm).
24. Number of Barr bodies inside cheek cell of male with Klinefelter's Syndrome.
25. Movement of water molecules into porous material causing swelling.
27. Number of haploid sets of chromosomes in a nonaploid cell.
28. Phase of plant mitosis when the cell plate forms.
29. One set of chromosomes from the mother.
32. One set of chromosomes from the father.
33. Intracellular (intravacuolar) plant structure composed of calcium oxalate.
34. Cell with only one set of chromosomes.
36. Season of the year when smallest, most dense oak wood cells are produced.
37. Season of the year when largest stem (xylem) cells of an oak are produced.
38. Protein strands that attach to centromere region during M-phase of cell cycle.
42. Smallest subunit of a living system--containing cytoplasm and organelles.



Unit 6 Mitosis

Chapter 6

Teacher Unit Must Knows	*Key Vocabulary*
1. Students will be able to differentiate between a gene, a DNA molecule, a chromosome, a chromatid, between homologous chromosomes, sex chromosomes and autosomes. They will be able to compare and contrast haploid and diploid cells and how changes in chromosome numbers or structures can affect development. a. Cell division allows organisms to reproduce asexually, grow, replace worn out or damaged tissues and form gametes. b. Bacteria reproduce through binary fission. c. At cell division, each chromosome consists of two chromatids attached at the Centromere. d. Each organism has a characteristic number of chromosomes. e. Human somatic cells are diploid, with 23 pairs of homologous chromosomes. Human gametes are haploid, with 23 chromosomes. f. Sex chromosomes carry information that determines an organism's sex. g. Changes in chromosome number or structure can cause abnormal development. Karyotypes are used to examine and individuals chromosomes. **2. Students will be able to identify the major events that characterize the five phases of the cell cycle, how it is controlled in eukaryotes and what role it plays in cancer.** a. The life of a eukaryotic cell, the cell cycle, includes Interphase, mitosis and Cytokinesis. b. Interphase consists of 3 phases: growth, DNA synthesis and preparation for cell division. A cell about to divide enters the mitosis and cytokinesis phases of the cell cycle. c. The cell cycle is carefully controlled; failure of control can result in cancer. **3. Students will be able to describe the stages of mitosis.** **a.** Prophase – Chromosomes condense, nuclear membrane dissolves, and spindles begin to move toward poles. **b.** Metaphase – Chromosomes line up along the middle. **c.** Anaphase – Spindle fibers guide chromatids to opposite sides of the cell. Nuclear membrane begins to reappear. **d.** Telophase – Chromosomes uncoil and spindles disappear. **4. Students will be able to differentiate Cytokinesis in plants and animals.** **a.** Cytokinesis occurs in animal cells when the cell membrane pinches in half. **b.** A cell plate forms during cytokinesis in plant cells	• Gamete • Binary fission • Gene • Chromosome • Chromatid • Centromere • Homologous Chromosome • Diploid • Haploid • Zygote • Autosome • Sex Chromosome • Karyotype • Cell Cycle • Interphase • Mitosis • Cytokinesis • Cancer • Spindle

Test Prep CheckList

Have I completed…

Key Terms…

- ☐ **Completed** and **know** all the Word Parts for this unit and the unit before?
- ☐ **Defined** and **studied** (flash cards help) the Key Terms for the Unit?

Reading Circles…

- ☐ **Completed** each of the reading circles for each of the sections in the book?
- ☐ **Taken** and **corrected** each of the Reading Quizzes for each section in the book?

Must Knows…

- ☐ **Identified** and have **written** the appropriate Must Know on the top of each page in the packet
- ☐ **Studied**, **Know** and **asked questions** for each of the Must Knows for this Unit.

Notes…

- ☐ **Taken** Cornell Notes for each day of the unit.
- ☐ **Generated** at least 5 questions for each page of notes.
- ☐ **Summary** is written for each page of notes

Organization…

- ☐ Everyday's Must Knows and Homework is written on the calendar or in an assignment notebook.
- ☐ Cornell Notes are stored in binder.

Word Parts Unit 6: Mitosis

Prefix

Pro-		**mi-**	
meta-		**Carcin/o**	
telo-		**Suffix**	
ana-		**-kinesis**	
cyto-		**-oma**	

Using your prefixes and suffixes break the word into parts and define the following:

Word	Prefixes and Suffixes Used	Meaning
prophase		
cytokinesis		
Anaphase		
mitosis		

Create the word based on the meaning:

Word	Prefixes and Suffixes Used	Meaning
		Phase of completion
		Abnormal condition of cell
		Cancerous tumor

Use the word parts above to make 3 other words:

Word	Prefixes and Suffixes Used	Meaning

Define the following word:

Word	Prefixes and Suffixes Used	Meaning
asexual		

Unit 6 Mitosis
Key Terms

Define the following…

- Gamete
- Binary fission
- Gene
- Chromosome
- Chromatid
- Centromere
- Homologous Chromosome
- Diploid
- Haploid
- Zygote
- Autosome
- Sex Chromosome
- Karyotype
- Cell Cycle
- Interphase
- Mitosis
- Cytokinesis
- Cancer
- Spindle

Must Knows:

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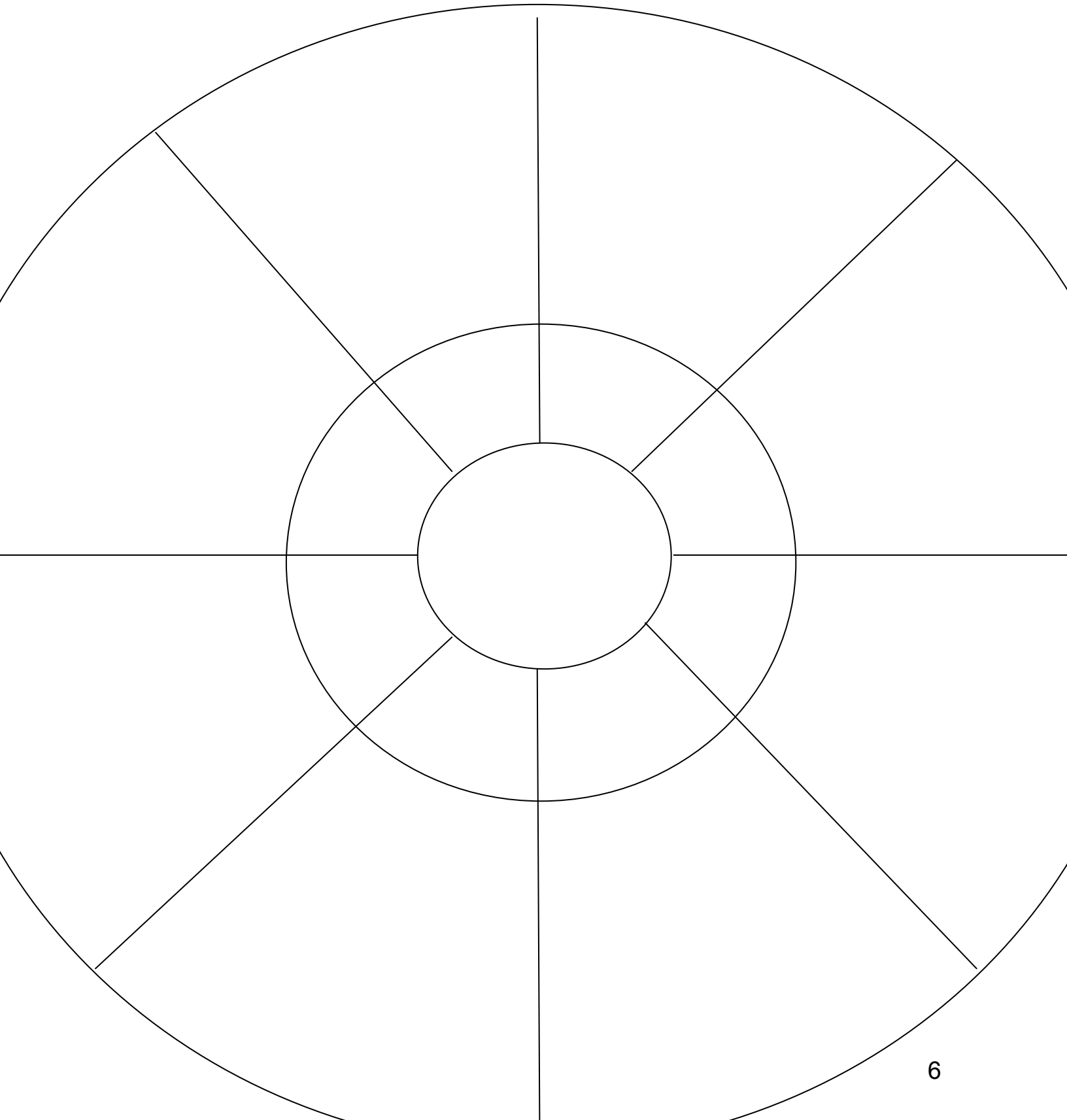

Must Knows:

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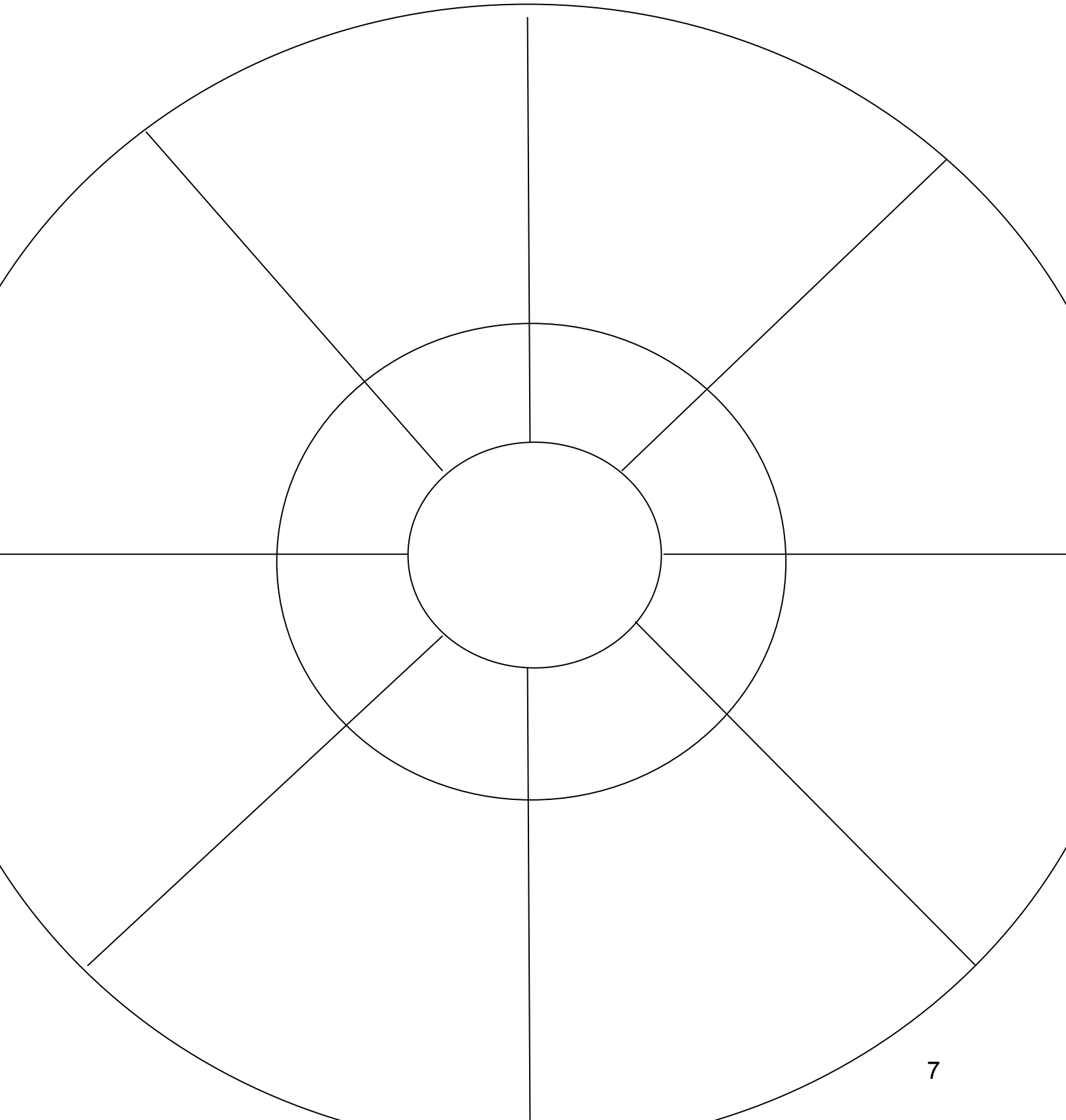

Must Knows:

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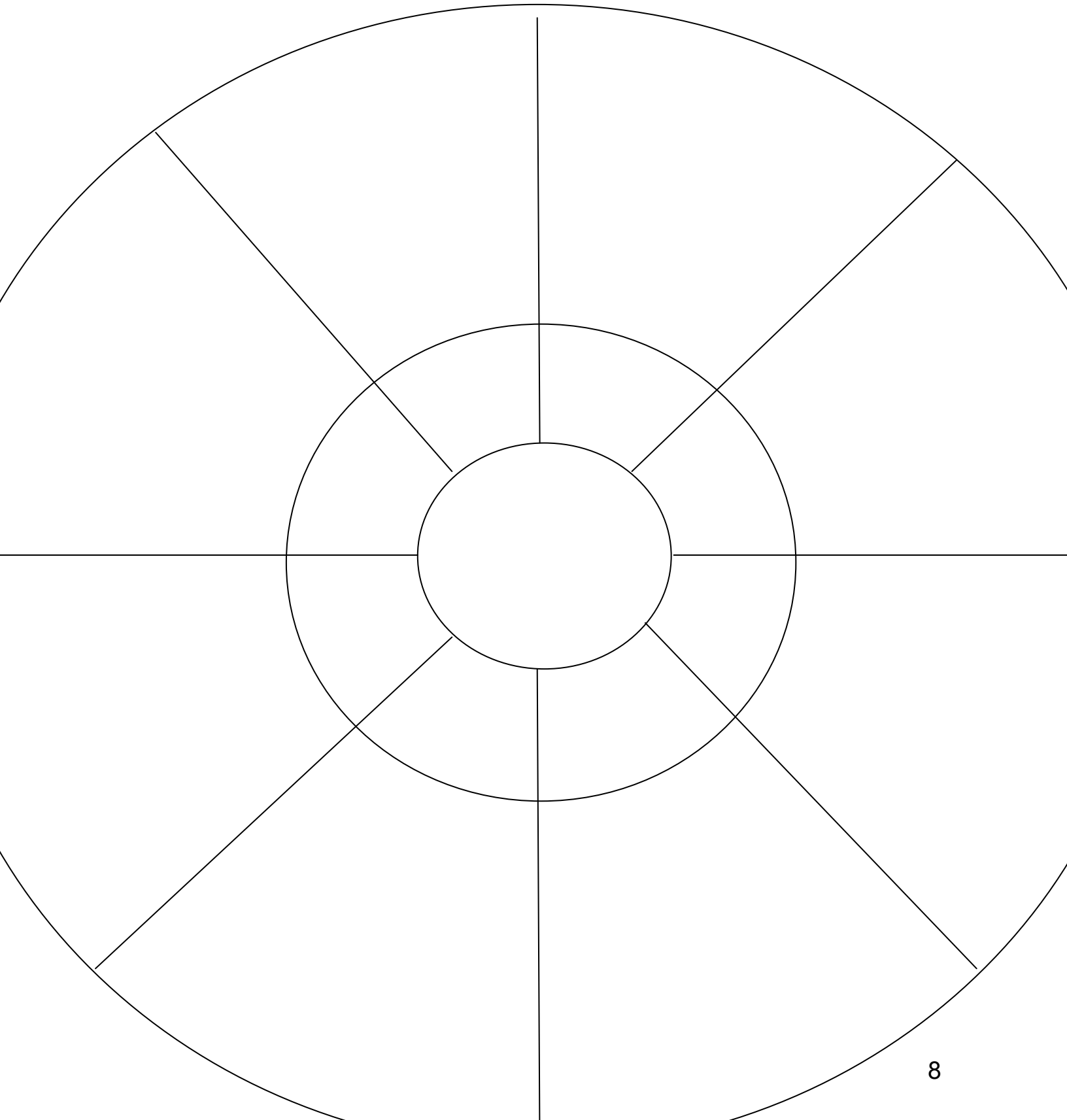

Must Knows:

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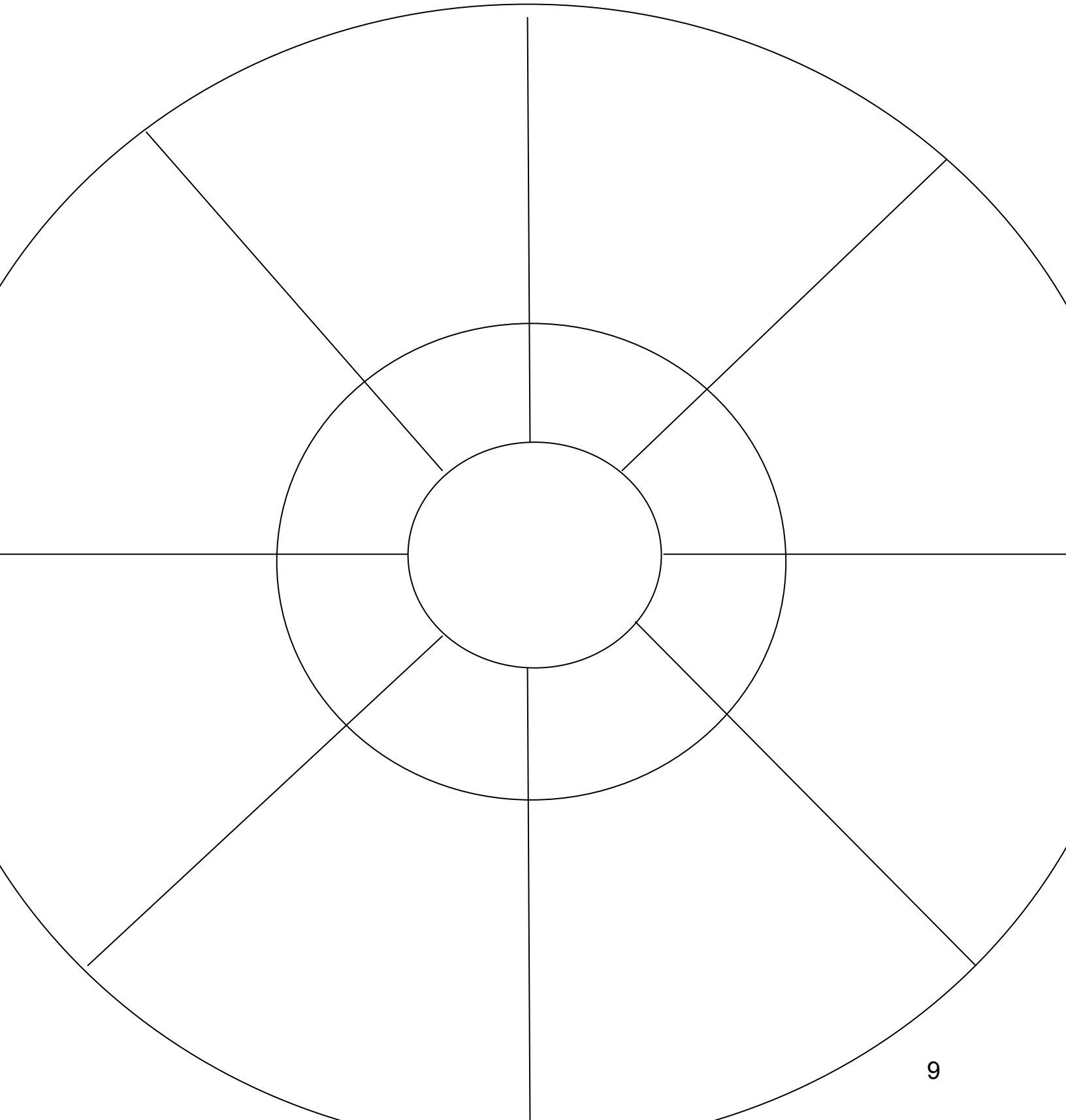

Must Knows:

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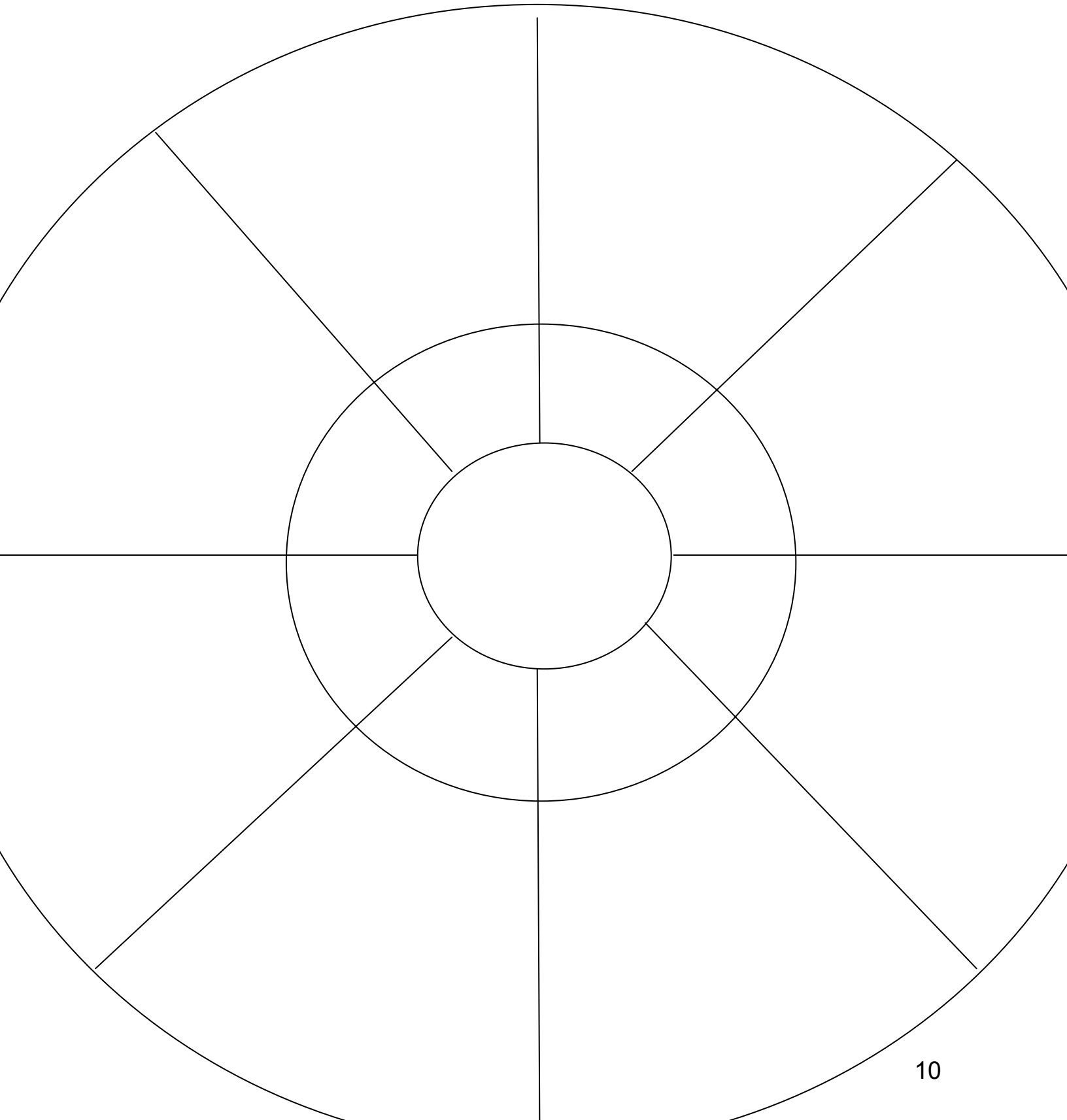

Must Knows:

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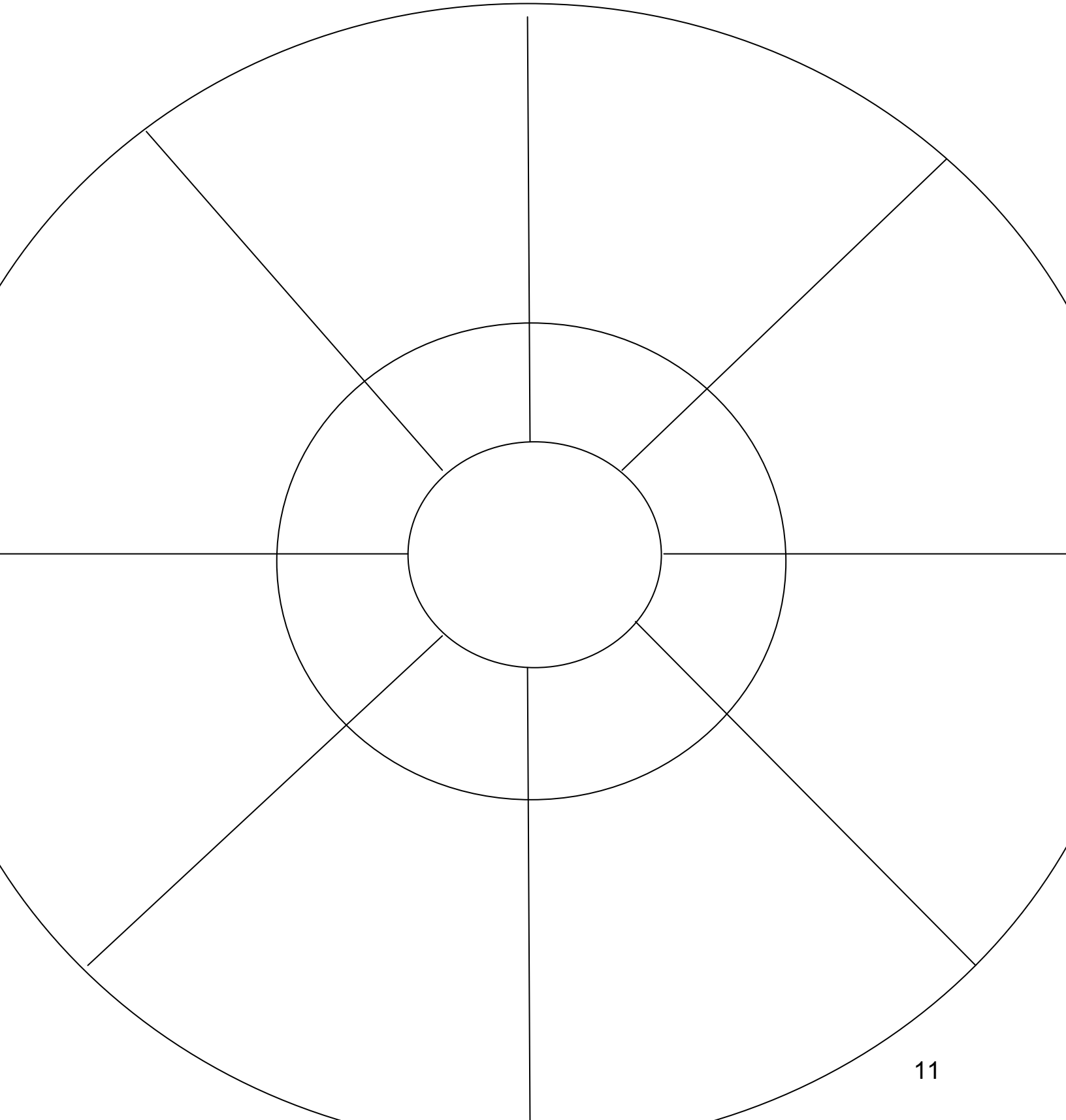


Bell Ringer Worksheet

Question:	**Date:**
Answer:	

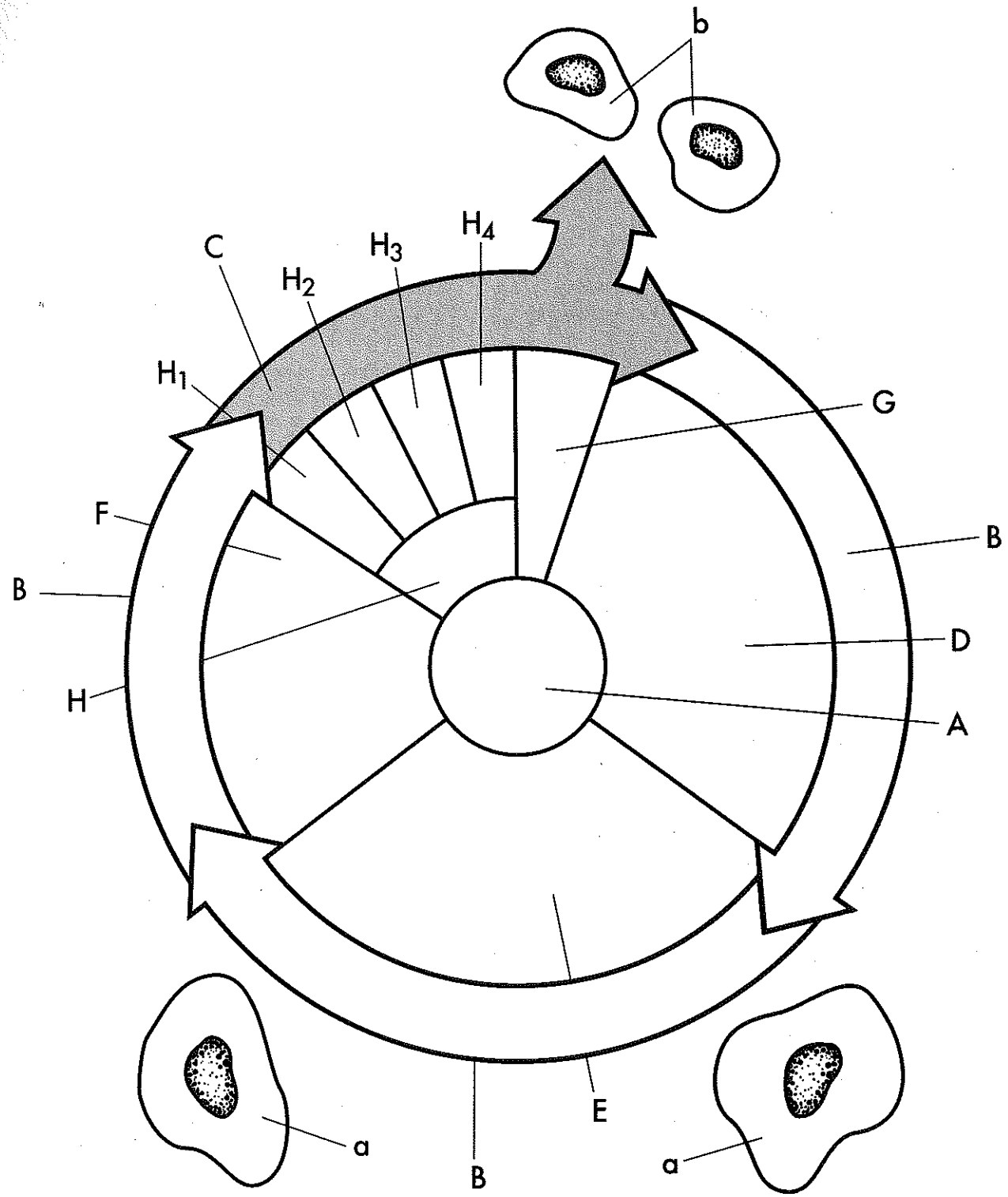
Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	

Question:	**Date:**
Answer:	



The Cell Cycle

- ○ The Cell Cycle .....A
  - ○ Interphase .....B
  - ○ M Phase (Cell Division) C
  - ○ G_1 Phase .....D
  - ○ S Phase .....E
  - ○ G_2 Phase .....F
  - ○ Cytokinesis .....G
  - ○ Mitosis .....H

Phases of Mitosis

- ○ Prophase .....H_1
- ○ Metaphase.....H_2
- ○ Anaphase .....H_3
- ○ Telophase.....H_4

- ○ Mother Cell .....a
- ○ Daughter Cells .....b

Chapter 2-15: The Cell Cycle

The cells of all living things grow and multiply through a cycle that's made up of four phases. During three of these phases, the cell is growing and is metabolically active. During the fourth phase, it is undergoing division, which yields two new cells. In this plate, we examine the four phases of the cell cycle and note the important characteristics and subdivisions of each phase. A subsequent plate explores the phases of mitosis in detail.

As you look over this plate, note that it contains numerous subdivisions that represent phases of the cell cycle. Bold colors may be used for these phases since there is little overlap and there are no fine details to obscure.

The **cell cycle (A)** takes place over different periods of time in different types of cells, and as you know, different types of cells coexist in many organisms. For example, in human fibroblast cells, the cell cycle may encompass about fifteen hours, while in brain cells, the cycle may take many years to complete.

The two major periods of the cell cycle are **interphase (B)** and the M phase (also known as the phase of **cell division (C)**). As the plate indicates, interphase encompasses three smaller periods and is the period of time between cell division. The same bold color may be used for all three portions of interphase, and a different color should be used for the M phase. Reds, blues, greens, or purples are suggested.

During interphase, the cell is extremely active and carries on routine cellular and physiological activities. For examples, cells of the pancreas are actively producing insulin, which facilitates the passage of glucose molecules into cells. During the M phase of cell division, the rate of metabolism is reduced and the cell undergoes division to form two cells.

We now focus on the three phases of interphase during the cell cycle. As before, bold colors should be used.

Three shorter phases make up the interphase period of the cell cycle. The first phase is known as the **G_1 phase (D)**. During this time period, metabolism is occurring at a high rate, many proteins are synthesized, and cell growth is vigorous; the G stands for growth. The cell's organelles also increase in number and size.

The second phase of interphase is the **S phase (E)**. In the S phase, some activities related to cell division take place (S stands for synthesis). The cell's DNA replicates, ensuring that future cells obtain similar copies of its hereditary material, and proteins associated with the DNA are produced during this phase.

The cell prepares to reproduce during the **G_2 phase (F)**. More of the proteins that are essential for cell division are produced during this brief phase, and these proteins move to appropriate sites. The centrioles used for cell division complete their replication during this phase. In addition to these activities, the cell continues its growth and many of its physiological processes.

Not all cells continue the cell cycle at this point; some cells leave the cell cycle and do not undergo cell division. Red blood cells (erythrocytes) are an example.

We complete the plate by focusing on the process of cell division that takes place during the M phase. More detailed descriptions of cell division are given in the next plate; a brief overview is given here.

At the conclusion of the G_2 phase, the cell enters its M (mitosis) phase of cell division. This phase consists of two main processes: the first is **mitosis (H)**, in which the chromosomes separate and segregate themselves on opposite sides of the cell, and the second is **cytokinesis (G)**, in which the cell actually splits. The results of cytokinesis and mitosis are shown in the plate.

Mitosis occurs as a series of events that are separated into four phases, and the process is continuous through these four phases. During **prophase (H_1)**, distinct chromosomes appear as a result of the uncoiling of the chromatin material (which is made up of DNA and protein). During **metaphase (H_2)**, the chromosomes line up along the equator. During **anaphase (H_3)**, the chromosomes separate, and one member of each pair moves to opposite poles of the cell. Lastly, during **telophase (H_4)**, the chromosomes arrive at the opposite poles of the cell and two distinct nuclei begin to form.

The processes that take place during the M phase of the cell cycle lead to new cells that are referred to as daughter cells. A single **mother cell (a)** has passed through the G_1, S, and G_2 phases and enters cell division to produce **two daughter cells (b)**. Each of the two new cells will now enter interphase and the cycle will be repeated.

Read the directions below before coloring the Mitosis diagram on the opposite side. These directions will guide you in the type of colors to use on the diagram. Make sure to color the titles the same color as the corresponding object.

Mendel's work went unappreciated for 35 years, by which time Mendel had died. Other biologists just weren't convinced that numbers had anything to do with biology. But during that 35-year period (1865-1900), great improvements were made in microscope lenses, and improved techniques for cell study (Plates 27 and 29) were developed. These advances led to the discovery of chromatin (Plate 30), so named because of the deep stain it takes from the appropriate dyes (Greek: *chromos*, "color"). In cell division the chromatin was seen to coil up into compact bundles called chromosomes as cells prepare to divide. In 1882 Walther Fleming worked out the details of the most common type of cell division, which is called mitosis (Greek: *mitos*, "thread") because of the threadlike appearance of the chromatin.

Although cell division is a continuous process, it is customary to divide it into four phases to make discussion easier. The period between divisions, when the cell is growing or just carrying out its life functions, is called interphase.

Color the heading Interphase at the upper right. Then color the headings Cell and Nucleus and titles A, D, E, and F. Color the cell beside the "Interphase" heading.

During interphase, the nucleus is surrounded by the nuclear envelope, and the *chromatin* is in the form of numerous loose threads. In cells of animals and primitive plants, a pair *of centrioles* is located in the cytoplasm just outside the nucleus. This plate illustrates division of such a centriole-containing cell.

Color the heading Prophase, all remaining titles, and the two prophase cells, one above and one below the Prophase heading.

Mitosis begins with prophase, in which the chromatin coils up and condenses into compact structures called *chromosomes.* Two prophase cells are shown, one early and one late, to emphasize the continuous nature of the process. As the chromosomes become shorter and thicker, it becomes clear that each one is made up of two subunits, which we call *chromatids.* If centrioles are present, a second pair of centrioles is synthesized during interphase, and a starlike array of microtubules called an *aster* forms around the centrioles. As prophase proceeds, the two pairs of centrioles move toward opposite sides of the cell, each with its own aster. During this migration, numerous additional microtubules are assembled between the centrioles to form the *spindle apparatus,* which is so named because of its similarity to the spindle of a spinning wheel. Many microfilaments of actin (one of the muscle proteins) become associated with the microtubules in the spindle. Any nucleoli present gradually become smaller and disappear. Eventually the asters arrive at opposite ends of the cell, and the spindle apparatus extends along one side of the nucleus. The nuclear envelope then disintegrates, marking the generally accepted end of prophase. (Cells without centrioles do not form asters but do form a very similar spindle, which is known as an anastral spindle, Latin: *an,* "without.")

Color the heading Metaphase and the structures in the two metaphase cells, one above and one below the heading.

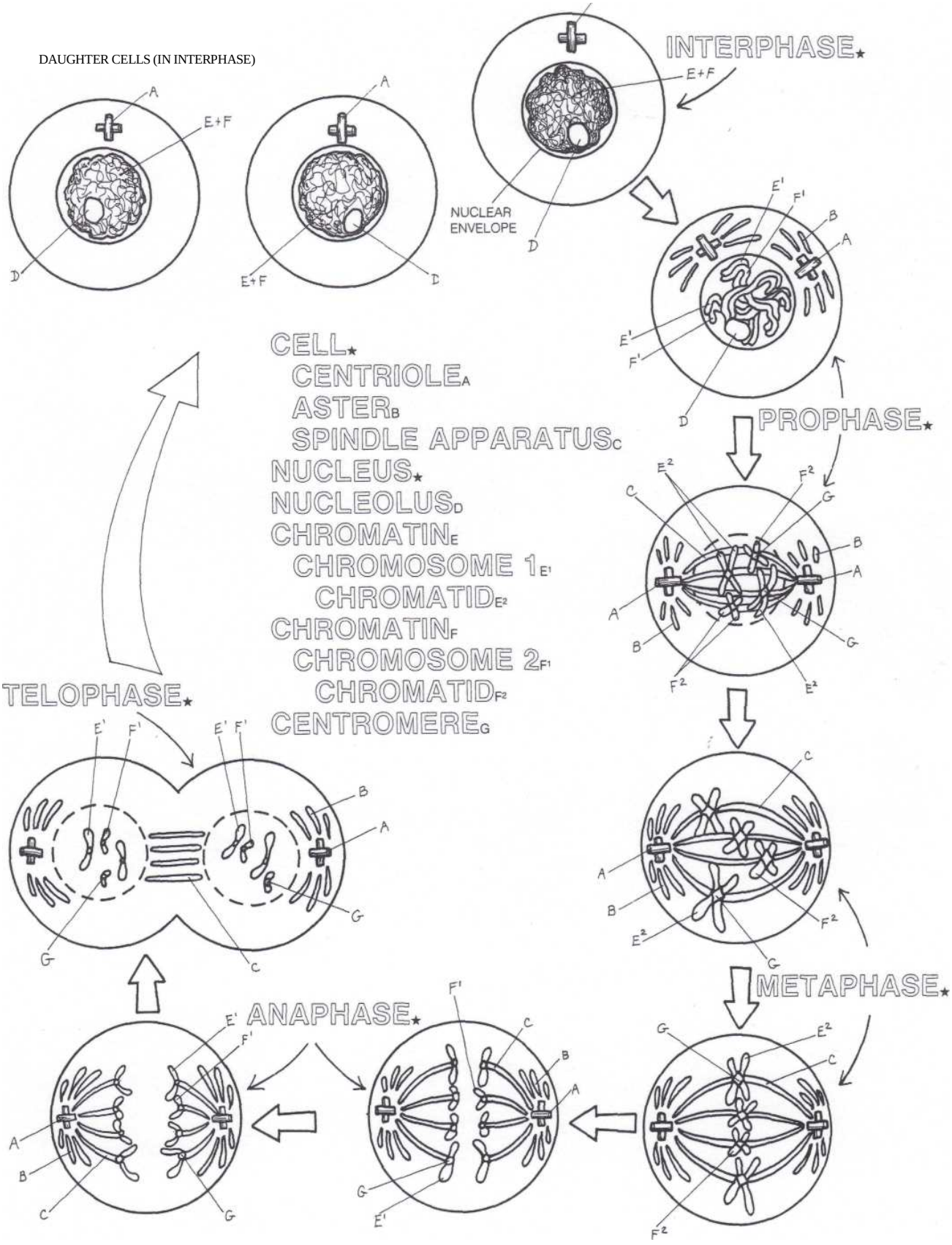
In the portion of mitosis designated as metaphase, the spindle apparatus moves into the area of the nucleus. As it does so, the chromosomes move to the center of the spindle. Each chromosome attaches by a specialized portion *(centromere)* to a different bundle of spindle microtubules. In animals and seed plants, virtually all the cells have their chromosomes in homologous ("same-proportioned") pairs. This is referred to as the "diploid" condition. As you will see in the next plate, gametes are "haploid" (Greek: *haplos,* "single"), having only one chromosome of each pair. (Haploid cells can also divide by mitosis in some organisms but not in animals.) The number, size, and shape of the chromosomes is constant for any given species. Humans have 23 pairs of chromosomes; other species have chromosome numbers ranging from one pair to more than 200 pairs.

Color the headings Anaphase and Telophase and the corresponding cell structures. Then color the two daughter cells in the upper left corner.

In anaphase, the chromatids of each chromosome separate to form two daughter chromosomes. The spindle tubules pull these daughter chromosomes to opposite sides of the cell so that each end of the daughter cells has an identical set. In telophase, the spindle dissolves, the chromosomes uncoil and become a diffuse chromatin network again, and the nucleolus and nuclear envelope reappear. In most cells, the cytoplasm is then divided to form two separate cells, each surrounded by its own membrane, as illustrated at the upper left.

Name_____ Date_____ Class____

Mitosis Coloring Diagram



Name _____ Class _____ Date _____

Skills Worksheet

Test Prep Pretest

In the space provided, write the letter of the term or phrase that best completes each statement or best answers each question.

_____ **1.** As a cell prepares to divide, a DNA molecule and its associated proteins coil to form a
- **a.** chromatid.
- **b.** gene.
- **c.** chromosome.
- **d.** centromere.

_____ **2.** What is the number of chromosomes found in a human body cell?
- **a.** 23
- **b.** 46
- **c.** 48
- **d.** 64

_____ **3.** The sex of a human offspring is determined by
- **a.** the female.
- **b.** the male.
- **c.** both the female and the male.
- **d.** neither the female nor the male.

_____ **4.** Bacteria reproduce through an asexual process called
- **a.** meiosis.
- **b.** cytokinesis.
- **c.** interphase.
- **d.** binary fission.

_____ **5.** In plant cells, cytokinesis requires the formation of a new
- **a.** Golgi apparatus.
- **b.** cell wall.
- **c.** centromere.
- **d.** series of protein threads.

_____ **6.** Gene mutations that result in cancer often cause the
- **a.** overproduction of growth-promoting proteins.
- **b.** underproduction of growth-promoting proteins.
- **c.** activation of control proteins that slow or stop the cell cycle.
- **d.** Both (a) and (c)

_____ **7.** Which of the following is NOT part of the spindle apparatus in animal cells?
- **a.** microtubules
- **b.** belt of protein threads
- **c.** spindle fibers
- **d.** centrioles

Name _____ Class _____ Date _____

Test Prep Pretest *continued*

Complete each statement by writing the correct term or phrase in the space provided.

8. A(n) _____ is a segment of DNA that transmits information from parent to offspring.

9. An individual with an extra copy of chromosome 21 demonstrates traits collectively known as _____ _____ .

10. The 22 pairs of chromosomes in human somatic cells that are the same in males and females are called _____ .

11. The human chromosomes that determine an individual's sex are called the _____ _____ .

Questions 12–17 refer to the sequence below.

$G_1 \longrightarrow S \longrightarrow G_2 \longrightarrow M \longrightarrow C$

12. The sequence above represents the _____ _____ .

13. The *S* in the sequence represents the phase in which _____ _____ occurs.

14. Phases G_1, S, and G_2 in the sequence above are collectively called _____.

15. Each individual protein structure that helps to move the chromosomes apart during mitosis is called a(n) _____ .

16. A disease caused by uncontrolled cell division is _____ .

17. In the first stage of binary fission, the DNA is _____ .

Read each question, and write your answer in the space provided.

18. What happens to the structure of DNA in your cells prior to cell division?

_____

_____

_____

Name _____ Class _____ Date _____

Test Prep Pretest *continued*

19. Explain the difference in the number of chromosomes between a frog somatic cell and a frog egg cell.

20. What happens when nondisjunction takes place during cell division?

21. Describe what happens at each checkpoint during the cell cycle.

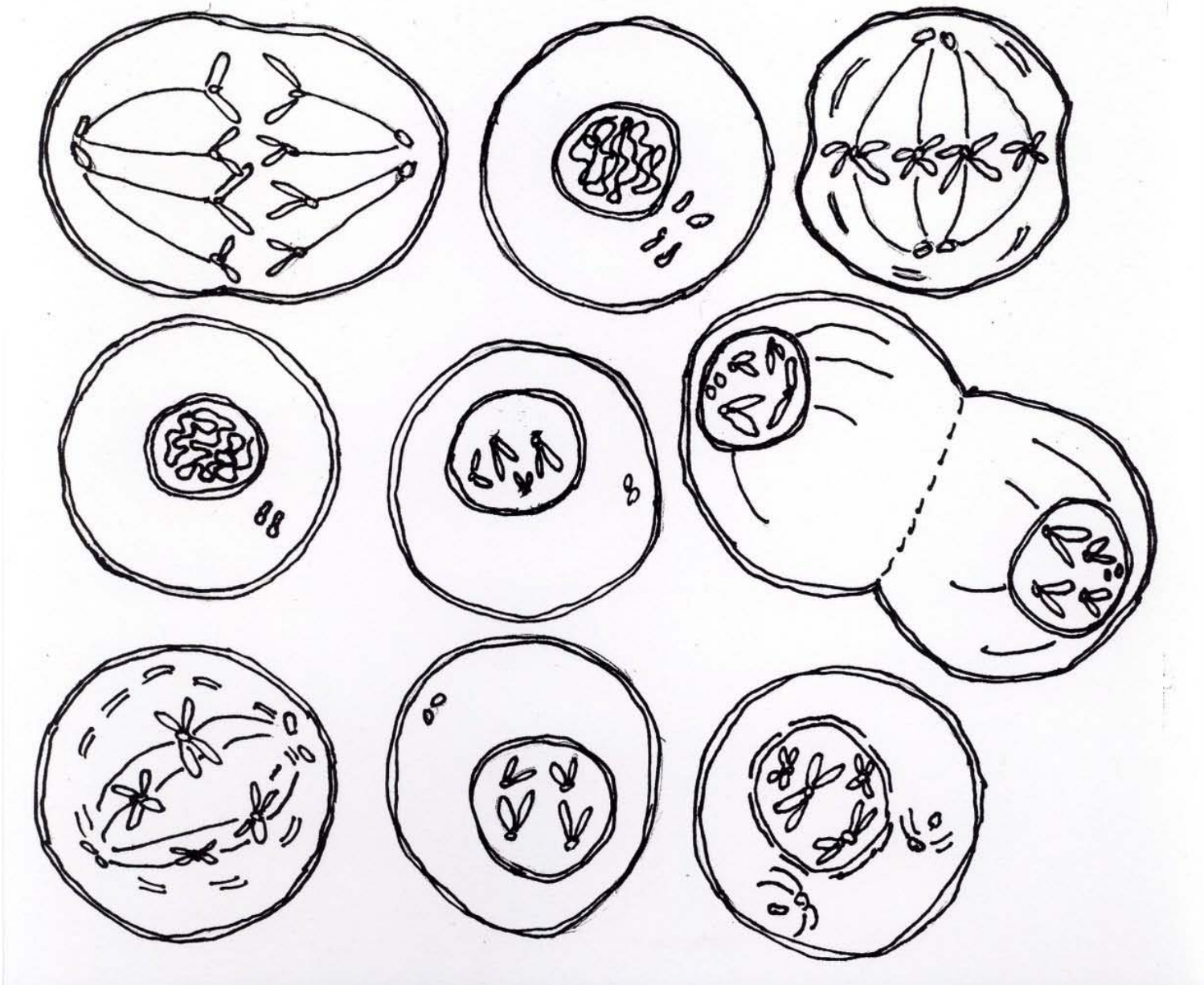
22. What are the four stages of mitosis in the correct order?

23. Explain the events that take place during each stage of mitosis.

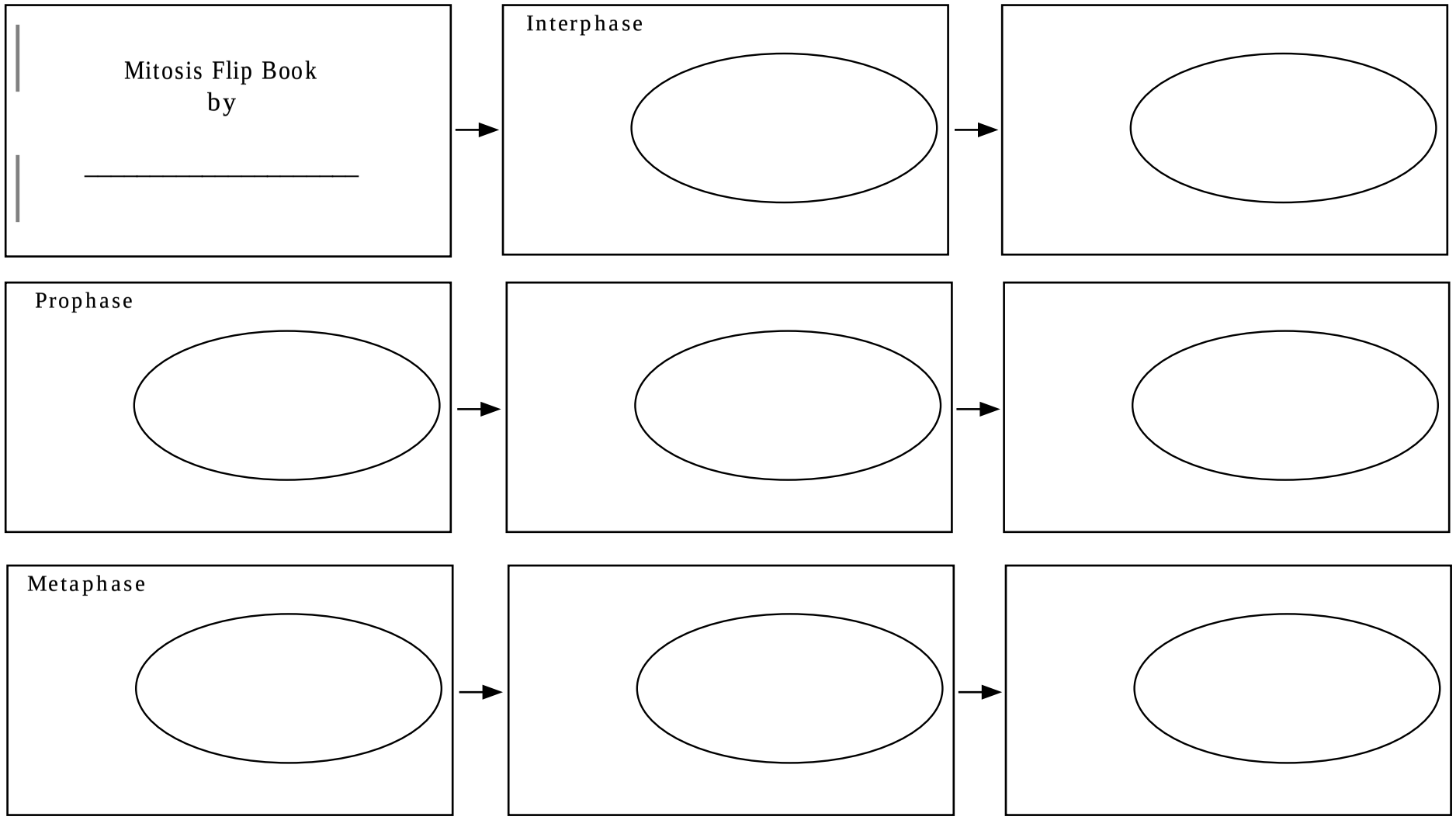
SNEAKERDOG'S PHASES OF MITOSIS WORKSHEET

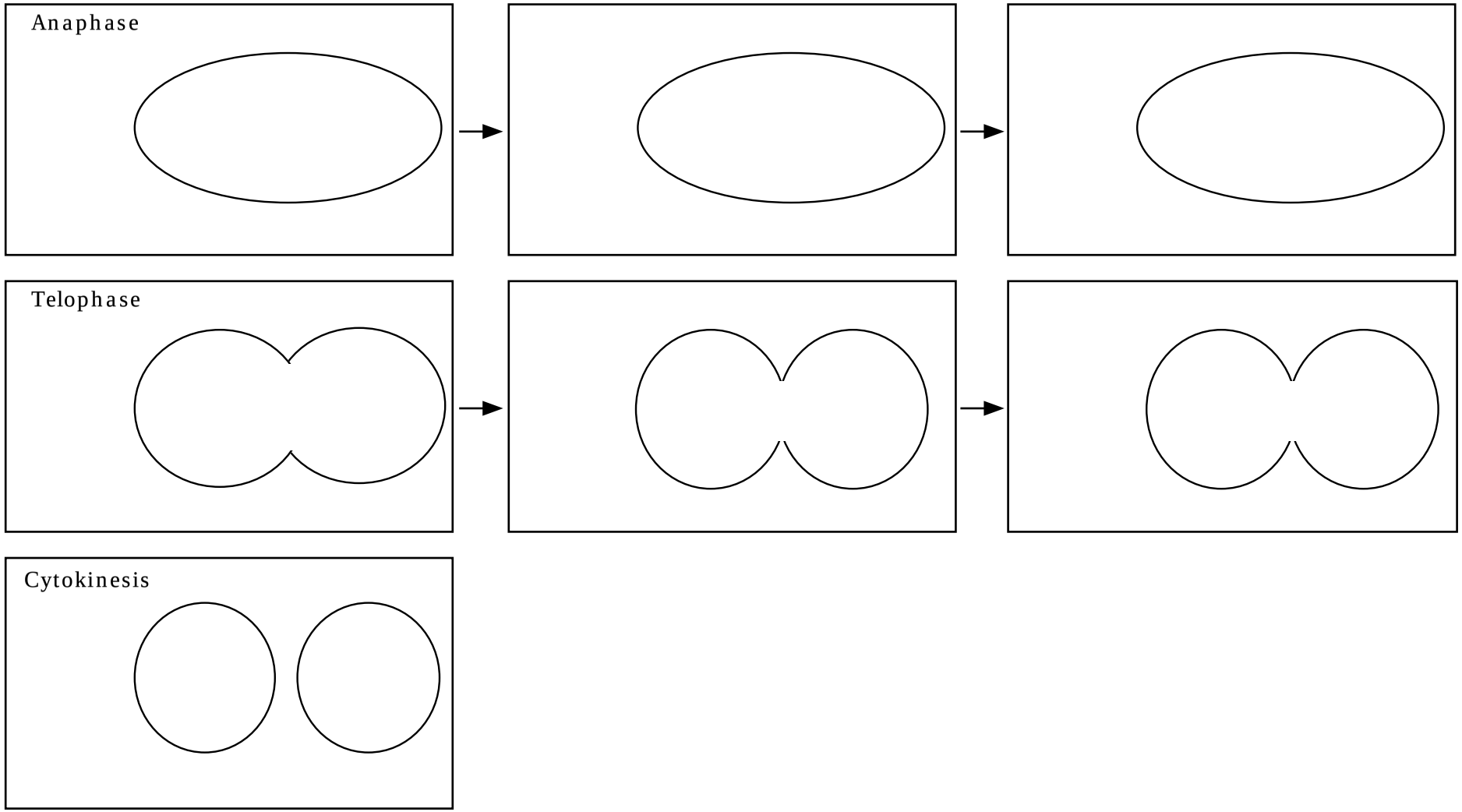
Cut out around the cell drawings. As you read in your textbook about cell reproduction, arrange the drawings in sequence, so that the illustrations represent the correct order of the phases of mitosis: Prophase, Metaphase, Anaphase, and Telophase (PMAT). Cut out the four labels. When you know you have placed the drawings in the correct order, glue the cell drawings onto piece of paper, so that you have a mini-poster of mitosis. Glue each label under the correct illustration for the name of the phase. Label the chromatin, centrioles, chromosomes, spindle fibers, sister chromatids, and centromeres. Take your poster and display it near your bed. Then you can dream about the amazing phases of mitosis!

PROPHASE METAPHASE ANAPHASE TELOPHASE



You will complete each page to illustrate the changes that take place in a cell during cell division. The first oval (or ovals) in EACH phase should show the location of the organelles at that stage. Use the extra ovals to show the movement of organelles between stages. Once you have completed all the diagrams, carefully cut out each page, organize from first to last, and staple! Flip through your book to view cell division!




Anaphase
Telophase
Cytokinesis